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TECHNOLOGY UTILIZATION

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COMPUTER PROGRAMS: SPECIAL APPLICATIONS

A COMPILATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Foreword

The National Aeronautics and Space Administration and the Atomic Energy Commission have established a Technology Utilization Program for the rapid dissemination of information on technological developments which have potential utility outside the aerospace and nuclear communities. By encouraging multiple application of the results of their research and development, NASA and AEC earn for the public an increased return on the investment in aerospace and nuclear research and development programs.

This compilation of computer programs has been divided into three categories: engineering and design; measurements and testing; and navigation and tracking. These items are only samples of many similar items that are available through the TU program. The enormous volume of information available in this fertile area is indicative of the important role that computer programs have played in the aerospace program.

In general, the compilation items are moderately complex and as such would appeal to the applications engineer. However, the selection criteria were tailored so that the circuits would reflect fundamental design principles and applications, with an additional requirement for simplicity whenever possible.

Additional information on individual items can be requested by circling the appropriate number on the Reader Service Card included in this compilation; or from: COSMIC, 112 Barrow Hall, University of Georgia, Athens, Georgia 30601.

We appreciate comment by readers and welcome hearing about the relevance and utility of the information in this compilation.

Jeffrey T. Hamilton, *Director*
Technology Utilization Office
National Aeronautics and Space Administration

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Contents

Section 1. Engineering and Design Programs

HYDROFOIL SECTION ORDINATES CALCULATIONS

This program calculates nondimensional hydrofoil or propeller section ordinates at fixed chordwise abscissa. The NACA 16-Series symmetrical thickness distribution is added normal to the camberline. The program offers the following two output options:

OPTION I – Table of offsets for lofting
OPTION II – Input data for DTMB Program 840-041.

Output for Option II of this program may be used without change as input to David Taylor Model Basin (DTMB) Program 840-041, which calculates the pressure distribution around any closed shape. This DTMB program is described in DTMB Report 1821, 1965.

Two subroutines are used to calculate:

a. NACA 16-Series thickness ordinates, (Y_t, V5YT)[1], and
b. DTMB "c" camberline ordinates, (Y_c, V5YC).

The NACA "a" camberline is a special case of the DTMB "c" camberline. Since thickness and camberline calculations are subroutines, a variety of thicknesses or camberlines may be developed, as the need arises, with minor revision to the main program.

Language: FORTRAN IV
Machine Requirements: IBM-7090

Source: Naval Ship Engineering Center
(DOD-00004)

Circle 1 on Reader Service Card.

HYDROFOIL SHIP LONGITUDINAL, STATIC, TRIM LOAD PROGRAM

This program computes the foil control surface deflection angles necessary to produce static equilibrium for a hydrofoil ship operating at a specified hull clearance, pitch angle, and velocity. Assuming the hull can be represented by a prismatic planing hull, the conditions through a quasistatic (i.e., ignoring accelerations and rates) takeoff can also be determined. The program computes and tabulates the individual forces acting on the ship and outputs them for ready reference.

Language: FORTRAN IV
Machine Requirements: IBM-7090

Source: Naval Ship Engineering Center
(DOD-00003)

Circle 2 on Reader Service Card.

SUBROUTINE FOR THE THERMODYNAMIC PROPERTIES OF STEAM AND WATER

SMTAB was developed to determine the thermodynamic properties of steam and water. The properties as determined by this program agree closely with the properties tabulated in the Keenan and Keyes' tables. Table look-up was not used because of inefficiency and the large amounts of core storage required. Instead, SMTAB makes use of Keenan and Keyes' equations, as well as curve-fitting and surface-fitting techniques, to determine the required properties.

Language: FORTRAN IV
Machine Requirements: IBM-7090

Source: Naval Ship Engineering Center
(DOD-00007)

Circle 3 on Reader Service Card.

TRANSFORMER OPTIMIZATION COMPUTER PROGRAM

A computer program has been developed for performing transformer optimization. In using this program, values of flux density, frequency, primary and secondary voltage and current, materials constants, and input volts per turn ratio must be known or assumed. Given these parameters, the program computes:

1. primary and secondary turns, resistance, length of windings, and losses;
2. core size, volume, weight, and losses;
3. voltage regulation; and
4. overall transformer efficiency.

Results are computed versus volts per turn ratio.

Since frequency and flux density are not included in the transformer optimization routine, the program is not complete. In its present condition, it would make a good subroutine in a more general transformer optimization program.

Language: FORTRAN IV

Machine Requirements: IBM-7094

Source: P. Ramirez and H. Dove of
Electro-Optical Systems, Inc.
under contract to
Lewis Research Center
(LEW-10299)

Circle 4 on Reader Service Card.

MASS MOMENTS OF INERTIA FOR COMPOSITE BODIES

Studies of the rotational dynamics of spacecraft require the knowledge of the mass characteristics of the spacecraft. These characteristics include spacecraft weight, location of the center of mass, principal mass moments of inertia, and the directions of the principal axes of inertia. Laboratories to measure these characteristics experimentally may not be readily available or cannot handle spacecraft of large size and mass. Therefore, a mathematical model which treats the spacecraft as a composite body was developed and programmed for digital computer processing.

The mathematical model of the mass characteristics of a composite body is based on the fact that the moments and products of inertia of composite bodies are found by summing the moments and products of inertia of the individual components or particles.

The accuracy of the mathematical modes is dependent on the accuracy of the mass characteristics of the individual components. Ideally, accurate mass characteristics of each component would be found in a laboratory which measures the quantities experimentally. If this is not possible, the component may be assumed to be a homogeneous mass of a regular geometric shape. Standard formulas may be used to calculate the moments and products of inertia about axes parallel to the reference system. If the center of mass is not found experimentally, assuming a homogeneous mass distribution locates the center of mass at the geometric center of each component.

Less accurate results will be obtained if any of the above assumptions or simplifications are made, in calculating the inertia tensor and center of mass, rather than experimentally measuring these mass characteristics. For any method, the resulting component inertia tensor would be the input data to the computer program.

Language: FORTRAN IV

Machine Requirements: IBM-7094 II/7044 Direct Couple System

Source: J. E. Cake
Lewis Research Center
(LEW-10901)

Circle 5 on Reader Service Card.

COMPUTER PROGRAM FOR DESIGN OF SUPERSONIC INLETS

This FORTRAN IV computer program, which incorporates the method of characteristics, was written to assist in the design of supersonic inlets. There were two objectives: (1) to study a greater variety of supersonic inlet configurations and (2) to reduce the time required for trial-and-error procedures to arrive at optimum inlet design.

The computer program was written with the intention of being able to construct a variety of inlet configurations by interchanging specific subroutines. In this manner, greater flexibility of choice was attained, and the time required to program a specific inlet configuration was greatly reduced.

The second objective was accomplished by a reformulation of the boundary value problem for hyperbolic equations. By this reformulation of the boundary data, the engineering design quantities, throat Mach number, and flow angle were introduced as direct input quantities to the computer program. As a consequence of introducing the engineering parameters as input, the computer program will calculate the surface contours required to satisfy the specific throat conditions; inviscid flow is assumed, and the method used to calculate the inlet contour results in minimum distortion to the flow in the throat.

Language: FORTRAN IV
Machine Requirements: IBM-7094

Source: B. H. Anderson
Lewis Research Center
(LEW-10868)

Circle 6 on Reader Service Card.

COMPUTER PROGRAM FOR DETERMINING EFFECTS OF CHEMICAL KINETICS ON EXHAUST-NOZZLE PERFORMANCE

The performance of hypersonic ramjets and rockets can be strongly dependent on the chemical kinetic processes of the exhaust gases. These engines usually have combustion temperatures high enough to cause a high degree of dissociation of the products of combustion. If the recombination process is not fast enough, some of the dissociation energy is lost with a consequent penalty in thrust and specific impulse.

This computer program has been developed to compute nozzle performance, including chemical kinetic losses in the nozzle for rockets and subsonic or supersonic combustion ramjets. The kinetic analysis is designed for any chemical system in which the change in molecular weight is due to the three-body recombination reactions only, and one in which the energy exchange through the bimolecular reactions is small in comparison with that of other reactions. Nonequilibrium effects on nozzle performance are determined by making use of Bray's Criterion. With this approach, the gases at the nozzle entrance are assumed to be in chemical equilibrium; that is, the composition is that corresponding to a complete or steady-state adjustment to local temperature and pressures at each point in the exhaust nozzle. The engine performance is then determined by assuming that at some later point in the nozzle, as located by using Bray's Criterion, the flow is assumed to "freeze"; that is, the composition no longer varies throughout the remainder of the nozzle expansion. Bray's Criterion is applied by determining, in the nozzle, a sudden freezing point that is characterized by the net rate of change in the number of moles becoming approximately equal to the recombination rate.

The program can also be used for equilibrium and frozen or specified freezing point calculations for any rocket propellant system or ramjet fuel.

Language: FORTRAN IV (94%), DATA (6%)
Machine Requirements: IBM-7094

Source: L. C. Franciscus and J. A. Healy
Lewis Research Center
(LEW-10902)

Cirlce 7 on Reader Service Card.

COMPUTER PROGRAM FOR DESIGNING COMPRESSOR BLADES

A compressor blade shape widely used in transonic compressors is composed of circular arc segments. An accurate dimensional description of the blade is needed for both flow analysis and fabrication. Such dimensional descriptions are usually obtained manually from large-scale graphical design drawings used in the mechanical design of a compressor blade. A blade-element layout method and stacking procedure have been converted to mathematical equations in a computer program that permits simulation of a complete compressor blade. The layout method simulates the circular-arc-type blade element on a cone with the preservation of the constant rate of angle change. The computer program is capable of handling a multiple circular-arc blade element. It calculates blade cross-section coordinates and geometric properties for mechanical design and stress analysis.

Much of the compressor blade aerodynamic performance data is generated in two-dimensional cascades, where the test blade section lies in a plane surface, and in low-speed machinery, where the test blade section lies on a cylindrical surface. When applied in high-performance transonic compressors, these same blade sections are placed on conical surfaces which approximate the flow streamlines. This computer program defines a line which has a constant angle change with arc distance on the conical surface, thus retaining the principal characteristic of the plane circular arc. The program is versatile in that a complete blade section may be composed of one or two circular arc segments, with the maximum thickness located in either segment or at the transition point. The individual blade sections are stacked on a line, which may be tilted a specified amount in both the axial and tangential directions.

Program outputs are the coordinates of the blade sections on conical surfaces, as used in analysis procedures, and on plane surfaces, as used in fabrication methods. In addition to the coordinates, parameters for stress analysis (such as area, center of area, and moments of inertia) are also computed.

Language: FORTRAN IV

Machine Requirements: IBM-7044/7094

Source: J. E. Crouse, D. C. Janetzke, and R. E. Schwirian
Lewis Research Center
(LEW-11059)

Circle 8 on Reader Service Card.

TRANSPORT OF ATOMIZED DROPS IN WET VAPOR TURBINES (ADROP)

ADROP is designed to examine in detail the transport of atomized condensate, from the stator exit plane to the rotor inlet plane, in wet vapor axial-flow turbines. The code facilitates parameter surveys and can be used to systematically test the implications of various assumptions made in the numerical model of the transport of atomized drops.

A single stage and blade height position is examined at one time; however, as many problems as necessary may be run consecutively. Temperature-dependent working fluid properties are computed by an auxiliary subroutine, with a capacity of eight materials: lithium, sodium, potassium, rubidium, cesium, mercury, Nak-78, and water. For a given stage and geometry, and for a given bulk flow condition, a range of drop sizes is introduced into the vapor stream at various wake positions. Terminal velocities are obtained for all drops. If the flow conditions are such that a drop satisfies the condition of aerodynamic instability, the approximate location of disruption is noted and the mass mean diameter of secondary drops is estimated.

Language: FORTRAN IV

Machine Requirements: CDC 3600, CDC 6400, CDC 6600

Source: Westinghouse Corp.
under contract to
NASA Pasadena Office
(NPO-10852)

Circle 9 on Reader Service Card.

ANALYSIS OF AN EJECTOR SYSTEM IN HOT GAS EXHAUST DUCT

This program analyzes the performance of an ejector system in an exhaust duct by determining ejector performance under varying operating conditions, exhaust duct configurations, and ejector configurations. In the design of an exhaust duct and a steam ejector for a rocket engine test system, it is necessary to assume many configurations, analyze them, and optimize a configuration design.

The memory-core requirements of this program are such that program revisions are possible without disrupting the existing program. Also, this program can be made compatible with other computer systems, with minimum alterations. Two analytical methods for evaluating the theoretical performance of various ejector configurations are available.

Input to the program consists of upper and lower limits of hot gas exhaust-nozzle chamber pressures and the pressure increments desired in the output. It also consists of the cross-sectional areas of the ejector throat nozzle and the exhaust duct. Chamber temperatures at various chamber pressures are also input. The primary output consists of the ratio of the total pressure of the exhaust gas to the atmospheric pressure, as a function of the ratio of the exhaust gas nozzle chamber pressure to the atmospheric pressure. The curve obtained by using these ratios as coordinates indicates the ejector performance.

Language: FORTRAN IV
Machine Requirements: IBM-1130

Source: Aerojet-General Corp.
under contract to
Space Nuclear Systems Office
(NUC-10336)

Circle 10 on Reader Service Card.

PARAMETRIC STUDY OF VARIATIONS IN WEIGHT AND PERFORMANCE CHARACTERISTICS OF LARGE-AREA SOLAR ARRAYS

This program was developed to provide results, in both tabular and graphical form, of a parametric study to establish relationships between performance characteristics and changes in design parameters for a large-area solar array (LASA) design concept. Variations in design parameters considered in the study included overall geometric scaling of subpanel planform, aspect ratio scaling of subpanel planform, scaling of applied inertial loading, changes in structural material properties, and changes in nonstructural weight.

The graphical results are presented in a catalog of plots which can be used to provide "quick look" evaluations of the characteristics to be expected for any new array design, which incorporates the basic features of the existing LASA design concept. These plots also illustrate the possible disadvantages, or advantages, associated with structural materials other than beryllium.

The parametric study results are not intended as a substitute for a complete and detailed structural analysis, which still must be performed for any array to be used in a spaceflight mission. These results can be used, however, as a guide during the preliminary design phase, to establish the first estimate of a suitable design to satisfy specified mission requirements.

Language: FORTRAN II (95.4%), OBJECT (4.6%)
Machine Requirements: IBM-1620

Source: JPL/Cal Tech
under contract to
NASA Pasadena Office
(NPO-11181)

Circle 11 on Reader Service Card.

PATHFINDING ALGORITHM FOR MYOPIC ROBOT

This program implements a pathfinding algorithm developed for an autonomous myopic roving vehicle. The development of this program was prompted by plans for future United States space missions, which will require an unmanned roving vehicle designed to explore the Martian surface. Direct control of the vehicle by an Earth-based operator, viewing a TV picture of the terrain, is not feasible because of the long transit times required for transmission of TV information from Mars to Earth.

The algorithm is based on the assumption that a path exists between two points on the surface of the terrain. The algorithm actually consists of three algorithms necessary to navigate the robot around obstacles. These are the main, left, and right scans. The decisions for the navigation, control, and obstacle avoidance of the rover are based mainly on myopic (local) information of the terrain. To simulate the topography of the terrain, the author uses Gaussian density functions.

Any devious route excursions can be avoided by using gross terrain information available from previous Mars orbiter missions. This would provide a nominal optimal path from some initial point to a specified destination.

Language: FORTRAN IV
Machine Requirements: IBM-7094

Source: JPL/Cal Tech
under contract to
NASA Pasadena Office
(NPO-11174)

Circle 12 on Reader Service Card.

Section 2. Measurements and Testing Programs

AUTOMATIC TELEMETRY CHECKOUT

The Automatic Telemetry Checkout Program (ATCO) provides a computer printout for the automatic checkout portion of the telemetry checks. Four phases of the telemetry checks are involved: Preemphasis (PR), Lower Band Edge (LBE), Upper Band Edge (UBE), and Recorder Preemphasis (R).

Input data for the program is provided by one or more mission tapes, containing captured telemetry check data, and by cards, containing the bandpass limits for each channel used. In addition, data from cards are input, giving the number of reels for the mission tape, the number of Data Block Addresses (DBA's) preceding the telemetry checkout DBA, and the number of data-core words in each DBA.

The program output is in three parts, as follows:

1. A listing of the data cards, accompanied by messages, if cards are missing or out of place. The program is terminated if any card is missing or out of place.
2. Tape error messages, if tape errors occur during reading of the mission tape.
3. Printout, by phase, of the percent deviations for each transmitter channel. Individual values that are outside the allowable deviation are flagged with an asterisk. Also, if a transmitter has values that were taken from a record containing bad data, that transmitter is flagged (with an arrow pointing upward) preceeding the time. The report by phase is a different file than the data card listing and error messages.

One option is available in the program; namely, the input data cards containing the bandpass limits may be input by binary magnetic core (BMC) tape.

Language: FORTRAN IV (60%), GMAP (40%)
Machine Requirements: GE-635

Source: Kennedy Space Center
(KSC-10436)

Circle 13 on Reader Service Card.

PROPAGATION FROM AN ISOTROPIC RADIATOR

This program computes the angle of target above horizon, phase change, wavelength, field strength, and relative field strength, for an isotropic radiator at different heights of target, frequencies, heights of antenna, ground ranges, and reflectivities. All of the computed results, together with the frequencies, antenna heights, and target heights, are punched out for each reflectivity and ground range.

The program thus provides a true plot of the radiation pattern of an isotropic radiator, e.g., a radar. It does this by including the effects of the reflected waves, which are ordinarily omitted in textbook derivations of the equations describing radiation patterns.

Language: FORTRAN IV
Machine Requirements: IBM-7090

Source: Naval Ship Engineering Center
(DOD-00015)

Circle 14 on Reader Service Card.

STATISTICAL ANALYSIS OF PREFLIGHT CALIBRATION DATA

This program performs a statistical analysis of the d-value shifts between calibrations of the Centaur guidance system, in order to determine the stability of the gyros and accelerometers. The mean and/or the three-sigma standard deviation of the shifts for the following three sets of data are printed out in tabular form:

1. all calibration shifts,
2. calibration shifts with no shutdown, and
3. calibration shifts after shutdown (site-to-site shifts excluded for certain d-values).

The program also generates a tape of calibration data information to use with a general-purpose SC-4020 plot program.

Language: FORTRAN IV
Machine Requirements: CDC-6400

Source: H. E. Stalder of
General Dynamics Corp.
under contract to
Lewis Research Center
(LEW-10595)

Circle 15 on Reader Service Card.

EVA RADIATION HEAT TRANSFER PROGRAM

This program calculates the equilibrium radiation heat transfer between a man and a spacecraft during extravehicular activities. The contribution due to solar flux, Earth emission flux, and Earth albedo flux are input and integrated into the analysis of the system. The mathematical model of the system is composed of a cylinder and a flat plate, with internal shape factor, calculation capability.

This program consists of two subprograms: a main routine and one subroutine. The main program reads in data, makes all heat flux calculations, and controls printout. The subroutine calculates radiation shape factors.

Language: FORTRAN V (85%), DATA (15%)
Machine Requirements: UNIVAC 1108

Source: J. P. Kenny, Jr., of
Lockheed Electronics Co.
under contract to
Johnson Space Center
(MSC-13246)

Circle 16 on Reader Service Card.

YUL OCTAL DUMP EVALUATOR (YODEL)

Program YODEL provides a means of verifying (bit-by-bit) the validity of an Interpretively Simulated Apollo Guidance Computer (ISAGC) F-memory load, by comparing the actual contents of each F-memory core cell in the ISAGC DDP-224 with the value given for that cell in the octal listing section of the AGC program tape.

YODEL reads the octal listing section of the YUL assembler's output tape and compares the value given there for each F-memory cell with the actual value in the DDP-224 core. In the event of a discrepancy, a diagnostic message will be output. This message gives the address of the nonagreeing core cell, its actual contents, and its stated contents in the octal listing.

Language: DAP
Machine Requirements: DDP-224

Source: D. E. Alderman of
Lockheed Electronics Co.
under contract to
Johnson Space Center
(MSC-13178)

Circle 17 on Reader Service Card.

RAMAPO POUND-PER-SECOND TABLE PROGRAM

The Ramapo Pound-Per-Second Table Program will print out the control number, the serial number of both the subject flowmeter and the flowmeter calibrated with it, the range of calibration (high, medium, or low), the place and date of calibration, the medium used during calibration, the propellant for which the flow rates are valid, and the degree of curve used to generate the pound-per-second table.

Language: FORTRAN H
Machine Requirements: IBM-360, Release 11

Source: W. M. Cogswell and K. W. Fertig of
Rockwell International Corp.
under contract to
Johnson Space Center
(MSC-15925)

Circle 18 on Reader Service Card.

AGWRN – DECODING ROUTINE FOR SELECTED AGIWARN (URSIGRAM) MESSAGES

This program decodes selected Agiwarn (Ursigram) messages on solar and geophysical data, as distributed daily by the International Ursigram and World Days Service. The original messages can be copied directly from the incoming teletype printouts to punched cards.

Five different, commonly used messages can be decoded: Solar Flares (UFLAG, UFLAL), Solar Corona (UCORA), and Sunspots (USSPM, USSPO). Decoding takes place at a rate of approximately 5 to 10 records per average length message. The basic framework is set up so that subroutines for decoding other Agiwarn messages can be added easily. Messages which run over five punched cards cannot be handled.

Language: FORTRAN IV
Machine Requirements: IBM-1130

Source: JPL/Cal Tech
under contract to
NASA Pasadena Office
(NPO-10792)

Circle 19 on Reader Service Card.

ATMOSPHERIC ATTENUATION ESTIMATES FROM RADIO ASTRONOMY MEASUREMENTS

Microwave and millimeter-wave observations of extraterrestrial radio sources are affected by the opacity of the Earth's atmosphere, primarily because of oxygen and water content. This program is a method for relating a set of experimental data to the atmospheric opacity and intensity of an extraterrestrial source, in order to study the properties and constituents of the Earth's atmosphere.

For a plane Earth approximation, the equivalent noise temperature (T) of a radio source is related to the measured temperature (T) by

$$T = TL_O^{-\sec Z}$$

where

L_O = atmospheric attenuation at zenith, ratio (>1), and

Z = zenith angle, in degrees.

The best value in a statistical least squares sense for T and L_O is estimated from a series of measurements of T and Z at various zenith angles. The bias errors normally encountered by linearizing with logarithms are avoided by linearizing with a Taylor series expansion and solving by iteration. In addition, the measurement errors for L_O and T are estimated from the statistical data scatter.

Language: Fortran IV

Machine Requirements: IBM-7094/7044 Direct Couple System

Source: JPL/Cal Tech
under contract to
NASA Pasadena Office
(NPO-10609)

Circle 20 on Reader Service Card.

Section 3. Navigation and Tracking Programs

COORDINATE TRANSFORMATION EFG TO XYZ

This program converts position and velocity components in an Earth-centered cartesian system (EFG) to a cartesian system located at the Earth's surface (XYZ), and inversely.

The EFG system is right handed and space fixed with the E and F axes in the equatorial plane, the G axis coincidental with the rotational axis of the Earth and positive north, and the E axis cutting the meridian of the origin of the XYZ system at zero time. The XYZ system is an Earth-fixed, right-handed system with two possible definitions. The first of these, known as the Apollo Standard Coordinate System, has the Z-Y plane parallel to the plane tangent to the spheroid at the subpoint of the origin, with the X-axis directed along the normal to the Z-Y plane position upward. In this configuration, the Z-axis is the downrange axis and is directed by some azimuth, A. The Y axis (cross range) is directed by the azimuth plus 90 degrees. In the second configuration, the downrange axis is denoted by X, the cross-range axis by Z, and the vertical axis by Y.

The application of the program is not restricted to the Earth. The mathematics is flexible enough to be used with any rotating frame of reference, e.g., another planet. For this reason all Earth data are input and not presumed constant.

Language: FORTRAN IV

Machine Requirements: GE-635

Source: Kennedy Space Center
(KSC-10411)

Circle 21 on Reader Service Card.

SPHEROID CONVERSION PROGRAM

The spheroid conversion program provides a method for converting geographic coordinates from one geodetic datum to another. The mathematical technique used is based upon Molodensky's equations for geodetic datum conversion. An option is available that provides the capability of computing the geoidal separation.

Input to the program consists of the geographic coordinates to be converted, the semimajor and semiminor axes of each spheroid, the difference between the x y z coordinates of the spheroid, and the geoidal height of spheroid 1. Output consists of the computed geographic coordinates and, if desired, the geoidal separation presented in tabular form.

Language: FORTRAN IV

Machine Requirements: GE-635

Source: Kennedy Space Center (KSC-10405)

Circle 22 on Reader Service Card.

TRANSVERSE MERCATOR PROGRAM

The Transverse Mercator Program provides a method for converting geographic positions to plane coordinates or plane coordinates to geographic positions. The program uses a Transverse Mercator projection system with the central meridian at 81° W. longitude and origin at 24°20′ N. latitude. Tables taken from a publication of the U.S. Department of Commerce, Coast and Geodetic Survey, Special Publication 255, are used for the conversion methods. The table excerpts limit the use of the program to the area between 28° and 29° N. latitude and between 80° and 81° W. longitude.

The geographic position comprises the input to the program when converting to plane coordinates, or the plane coordinates (X,Y) comprise the input to the program when converting to geographic positions. A tabular printout of the converted plane coordinates or geographic positions, as applicable, is output from the program.

Language: FORTRAN IV

Machine Requirements: GE-635

Source: Kennedy Space Center (KSC-10406)

Circle 23 on Reader Service Card.

NORAD LOOK ANGLES AND PIO SATELLITE PACKAGE

This program package consists of two programs. First is the NORAD Look Angles Program, which computes satellite look angles (azimuth, elevation, and range) as well as the subsatellite points (latitude, longitude, and height).

The second program in this package is the PIO Satellite Program, which computes sighting directions, visibility times, and the maximum elevation angle attained during each pass of an Earth-orbiting satellite. Computations take into consideration the observing location and the effect of the Earth's shadow on the satellite visibility. Input consists of a magnetic tape prepared by the NORAD Look Angles Program and punched cards containing reference Julian date, right ascension, declination, mean sidereal time at zero hours universal time of the reference date, and daily changes of these quantities. Output consists of a tabulated listing of the satellite's rise and set times, direction, and the maximum elevation angle visible from each observing location.

Language: FORTRAN IV (99.4%), GMAP (0.6%)

Machine Requirements: GE-635

Source: Kennedy Space Center (KSC-10408)

Circle 24 on Reader Service Card.

SATELLITE POSITION AND INVERSE AZIMUTH TRACKING PROGRAM

This is a program which determines the latitude, longitude, and back azimuth of a satellite or missile tracking station and the distance, forward azimuth, and back azimuth (inverse) between two stations.

Given latitude and longitude of a point on the spheroid, the forward azimuth (measured at this position), and the distance along the spheroid to a second point, this program computes the latitude, longitude and the back azimuth for the second point.

Additionally, if given the latitude and longitude for each of the two points on the spheroid, this program computes the forward azimuth at point one, the back azimuth at point two, and the distance between the two points along the spheroid.

Language: FORTRAN IV

Machine Requirements: GE-635

Source: Kennedy Space Center (KSC-10407)

Circle 25 on Reader Service Card.

LOOK ANGLES OF CELESTIAL BODIES

This program computes look angles (azimuth and elevation) of celestial bodies, as seen from an observation point on the Earth's surface. These look angles are computed using ephemeris data from The American Ephemeris and Nautical Almanac.

The ephemeris input includes sidereal time, declination, right ascension, and horizontal parallax. Other input data are the coordinates of the observation point, its time zone number, and the time intervals within which the computation takes place.

The ephemeral parameters, for intermediate points between the reference values, are computed by Lagrangian interpolation. The look angles are computed from the ephemeris parameters, with spherical trigonometry expressions between the observation location and the apparent position of the celestial body.

Output data consist of the look angles of the celestial body for specified time points in terms of the standard time zone of the observation location.

Language: FORTRAN IV

Machine Requirements: GE-635

Source: Kennedy Space Center (KSC-10409)

Circle 26 on Reader Service Card.

SOUND LEVEL APPROXIMATION (SLAP I)

This program provides a method of approximating the relative intensity of sound emanating from a moving source. Wind considerations and the curved path of the sound wave propagation are neglected. The angle of elevation from the receiver to the moving source is approximated for line-of-sight considerations.

The input data, ϕ, λ, and H, are assumed to be geographic. These coordinates are converted to a geocentric, rectangular, right-handed cartesian system EFG, in which G is coincident with the polar axis so as to be positive in the northerly direction. E extends positively through the meridian of the receiver site. The elevation angle is in terms of a right-handed, pad-centered coordinate system XYZ, in which Y is positive upward along the geodetic vertical and X is positive downrange. The moving source positions are assumed to be on magnetic tape. Output is on the printer and consists of time, time delay, relative intensity of sound, elevation angle, and slant range.

Language: FORTRAN IV

Machine Requirements: GE-635

Source: Kennedy Space Center (KSC-10420)

Circle 27 on Reader Service Card.

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